MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal)
Department of Mechanical Engineering
For batches admitted in Academic Session 2018-19 Batch

Material Science

Category	Title	Code	Credit-4			Theory Paper
Engineering Science Course-ESC	Material Science	120301/190301/ BMEL305/ BAUL301/ MEL-302/3223	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	1	-	

Course Objectives: To make the students to understand:
1. The basic fundamentals of materials science and engineering.
2. The different classes of materials, their properties, structures and imperfections present in them.
3. The functional properties of materials and the roles of microstructure, heat treatment defects and environment play in typical engineering applications.

Syllabus

Unit-I Structure and Properties of Materials
Concept of crystalline and non-crystalline materials, Crystal structures analysis and Crystal system, Homogeneous and heterogeneous solidifications, Crystal imperfections. Miller indices and directions, Properties and uses of engineering materials. Stress-strain diagram for steels.

Unit-II Engineering Materials
Ferrous and non-ferrous metals and alloys, Nano-materials, Ceramic material, Composite material with their properties, uses and coding.

Unit-III Deformation of Materials
Types of deformations, Mechanism of deformations, Role of dislocations, Slip and twinning processes. Stages of deformation, Mechanism of ductile and brittle fracture.

Unit-IV Phase Diagrams
Concept of phases, Solidification of metals and alloys, Allotropy of iron, Fe-C diagram, Lever-rule, Eutectic, Eutectoid, Peritectic and Peritectoid systems.

Unit-V Heat Treatment of Steels
Micro constituents of steel, Importance of heat treatment processes, "S-curve and C-curve", Heat treatment processes and surface treatment processes.

Course Outcomes: After successful completion of this course students will be able to:

CO1. State the principles of diffusion theory and various types of defects in materials.
CO2. Discuss mechanical properties of materials
CO3. Compare the different processes to alter the material properties.
CO4. Determine the effect of different phases, impurities on the behavior of materials.
CO5. Analyze crystal structure and composition of different materials.
CO6. Create the different engineering materials and alloys.

Text & Reference Books

1. Elements of Material Science and Engineering **by** Lawrence, H. Vanvlackdison; Wesley.Mention the Year or the Edition and Publisher and Place of Publication
2. Material Science and Engineering **by** Raghvan, V; Prentice Hall of India.
3. Introduction to Engineering Materials **by** Agrawal, B.K; Tata McGraw Hill, N. Delhi.

NPTEL Link for Material Science

https://onlinecourses.nptel.ac.in/noc18_mm05/preview

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Mechanics of Materials/ Mechanics of Materials-I

Category	Title	Code	Credit-4			Theory Paper
			L	T	P	
Departmental Core-DC	Mechanics of Materials	120302/ 190302/ BMEL-302/ MEL-305/ 3225	3	-	2	Max.Marks-70 Min.Marks-22 Duration-3hrs.

Course Pre-Requisites:

Basic Civil Engineering and Mechanics (Subject Code – 100205)

Course Objectives: To make the students:

1. Learn the basic concepts and principles of strength of materials.
2. Calculate stresses and deformations of objects under external loadings.
3. Apply the knowledge of strength of materials on engineering applications and design problems.

Syllabus

Unit- I **Stress and strain**: Stress-strain relationship and elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain, compound and combined stresses, thermal stresses.

Unit-II **Stresses in beams**: Shear Force & Bending Moment diagram, theory of simple bending, Section Modulus, bending Stresses and Shear stresses in beam.

Slope and deflection: Equation of Elastic Curve, Macaulay's Method, Area Moment Method, Strain Energy Methods etc.

Unit- III **Shear stress distribution**: Horizontal, Vertical, Transverse, Longitudinal Shear Stress, Graphical Methods for Different Sections.

Shafts: Torsion of circular shaft, stress concentration in shafts; series and parallel combination.

Unit -IV **Column and Struts**: Euler's theory of column, Rankine's formula, slenderness ratio; strut with eccentric load.

Thin cylinder: Stress and Strain in thin cylinder, wire wound thin cylinder; thin spherical shells.

Unit- V **Materials testing**: Tensile, compressive, hardness, impact and torsion testing. Strain Gauges - types of strain gauges, electrical strain gauges, Gauge factor, strain rosette.

Strain Energy: Strain energy due to direct stress, simple shear, torsion, bending, shear force in beams.

Course Outcomes: After successful completion of this course students will be able to:

CO-1 **Identify** various structural elements and its application.

CO-2 **Illustrate** different types of stress and strain on various types of structural elements like beam, shaft column etc.

CO-3 **Calculate** principal stresses, maximum shearing stress, and the different stresses acting on a structural member.

CO-4 **Analyze** stresses and deflection for beam, shaft, long columns, thin cylinder etc.

CO-5 **Select** appropriate materials in design considering engineering properties, sustainability, cost and weight.

CO-6 **Design** simple bars, beams, and circular shafts to meet desired needs in terms of strength and deformation.

Text & Reference Books

1. Strength of Materials (MoM) **by** R S Lehri and A S Lehri; S K Katariya and Sons Pub.
2. Strength of Materials **by** S S Rattan; McGraw Hill Pub.
3. Mechanics of Materials **by** F P Beer, E R Johnston, J T DeWolf; TATA McGraw Hill Pub.
4. Strength of Materials **by** S. Timoshenko; D Van NostrandCompnay,
5. Mechanics of Solids **by** Mubeen; Pearson Education Pub
6. Strength of Materials **by** S Ramamrurtham, R Narayan; DhanpatRai sons Pub.
7. Strength of Materials **by** Sadhu Singh; Khanna Publisher Pub.
8. Mechanics of Materials **by**AdarashSwaroop, New Age international Pub.

NPTEL Link for Mechanics of Material

https://onlinecourses.nptel.ac.in/noc18_ce04/preview

LIST OF EXPERIMENTS

1. Tension test
2. Compression Test
3. Bending Test.
4. Single / Double Shear Test
5. Fatigue Test
6. Hardness test on metals - Brinell and Rockwell Hardness Number. Rockwell hardness Test
7. Impact test on metal specimen.
8. Spring Testing
9. To draw Bending moment diagram for simply supported Beam under point Loads.

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Evaluate** the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test.

CO2. **Conduct** the torsion test to determine the modulus of rigidity of given specimen.

CO3. **Perform** compression tests on spring and wood.

CO4. **Justify** the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen.

CO5. **Determine** elastic constants using flexural and torsion tests.

CO6. **Examine** the stiffness of the open coil and closed coil spring and grade them.

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120303: Theory of Machines-I

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-I	120303	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	2	

Course Pre-Requisite:
Engineering Graphics (Subject Code – 100105)
Mechanics of Materials (Subject Code – 120302)

Course objectives: To make the students:
1. Familiarize with different types of mechanisms.
2. Understand the basics of synthesis of simple mechanisms.
3. Apply fundamental of mechanics to machines which include engines, linkages etc.

Syllabus

Unit-I Mechanism: Machine, Mechanism, Kinematics Links, Pairs, Chains, Degree of freedom. Mechanisms and its Inversions; Slider, Double Slider and 4 bar mechanism. Lower pair mechanisms: pantograph, Straight line motions. Davis and Ackerman Steering Mechanisms.

Unit-II Kinematic Analysis: Displacement, velocity and acceleration analysis of plane mechanisms; relative velocity, instantaneous centre, Kennedy's Theorem, Klein's construction methods. Coriolis component.

Unit-III Dynamic Analysis: D'Alembert's principle. Equivalent dynamic system, Graphical and analytical methods of dynamic forces, analysis of mechanisms and machines including reciprocating engines.
Flywheel: Introduction, Turning-moment diagrams and Flywheel analysis.

Unit-IV Brakes: Analysis of simple brake assuming uniform pressures and uniform wear, band brake, block brakes, internal and external shoe brakes, braking of vehicles.
Clutches: Single plate and multi plate clutches, cone clutches, centrifugal clutches.
Dynamometers: Different types and their applications.

Unit-V Governors: Introduction, Types of governors, Various gravity and spring controlled governors, governor characteristics, Effort and power of a governor, Controlling force diagrams, Coefficient of insensitiveness.

Gyroscopes: Gyroscopic couple, Effect of Gyroscopic couple on the stability of four wheel and two wheel vehicles, Aeroplanes and Naval ships, Gyrostabilisers.

Course Outcomes: After successful completion of this course students will be able to:

CO 1. Identify basic mechanisms in real life applications.
CO 2. Discuss about mechanics of various machines.
CO 3. Apply fundamental principles of statics and dynamics to machinery.
CO 4. Analyze various types of motions and mechanisms of machinery.

CO 5. Compare various components suitable for different applications.e.g. different types of governor, clutch, brakes, flywheel etc.

CO 6.Create the mechanism or components to justify the demands of work.

Text &Reference Books:

1. Theory of Machines by Rattan, SS; TMH full detail of publicaiton
2. Theory of Machine by Norton, RL; TMH
3. Theory of Machine byBallaney, PL;Kanna Pub.
4. Mechanism and Machine Theory by Ambekar, AG; PHI.
5. Theory of Mechanism and Machines by Sharma, CS and Purohit K; PHI.
6. Theory of Machines by Bevan, Thomos; Pearson/ CBS PUB Delhi.
7. Mechanism and Machine Theory byRao, JS and Dukkipati; NewAge Delhi.
8. Theory of Machines byLal,Jagdish; Metropolitan Book Co; Delhi –
9. Theory of Mechanisms & Machines byGhosh,A.,Mallik,AK; Affiliated East West Press,Delhi.

NPTEL Link for Theory of Machines-I

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments (expandable)

1. Study of Kinematics links pairs and chains.
2. To find degree of freedom of a given mechanism.
3. To study all inversions of four-bar mechanisms using models.
4. Draw velocity and acceleration polygons of all moving link joints in slider crank mechanism.
5. Study of inertia forces in reciprocating parts and analysis of flywheel.
6. Study of various types of governors.
7. Study of various types of clutch.
8. Study of various types of brakes.
9. Study of various types of dynamometer.
10. Use virtual lab for any two experiments.

Lab Course Outcomes: After successful completion of this course lab students will be able to:

CO1. **Design** and **analyze** mechanism required for the specified type of motion.

CO2. **Draw** inversions and determine velocity and acceleration of different mechanisms.

CO3. **Construct** different types of cam profile for a given data.

CO4. **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.

CO5. **Compare** the various components related to machines and mechanism.

CO6. **Determine** the degrees-of-freedom (mobility) of a mechanism.

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120304: Fluid Mechanics and Hydraulic Machines

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Fluid Mechanics and Hydraulic Machines	120304/190304	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			3	-	2	

Course Objectives: To make the students understand:
1. Fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. And give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
3. And develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.

Course Pre-Requisite:
Basic Mechanical Engineering. (Subject Code – 100204)

Syllabus

Unit-I **Properties of fluid:** Pressure, density, specific weight, viscosity, dynamic and kinematic viscosity Newton's law of viscosity and its applications.
Fluid Static: Pressure variation with depth, pressure measurement, pressure on immersed surface centre pressure, Buoyancy, flotation, stability of floating bodies.
Unit-II **Fluid Kinetics:** One dimensional flow approximation, control volumes concept, continuity equation in 3-D, its differential and integral form, velocity and acceleration of fluid particle, stream line, path line. Rotation, vorticity and circulation. Stream function and velocity potential function. Flow net, Free and forced vortex flow.
Unit-III **Fluid Dynamics:** Momentum theorem, Impulse momentum equation and its application, Euler's equation in 3-D, Bernoulli's equation for incompressible fluid flow, engineering applications of energy equation, Pitot -Tube, Venturi meter, Orifice meter.
Unit-IV **Flow through Pipes:** Critical Reynolds's number, velocity distribution in pipes, friction factor. Moody's chart, Laminar flow through pipe, Hagen-Poiseulli's equation, Turbulent flow through pipe, Hydraulic gradient line and total energy line. Minor head losses in pipes, Pipe Networking and Transmission of power through pipes.
Unit-V **Water Turbine:** Impulse and Reaction principles, Pelton, Francis and Kaplan turbines, velocity diagrams, Work done by turbines, Draft Tube theory.

Course Outcomes: After successful completion of this course students will be able to:

CO1: **Define** the fundamental properties of fluids.
CO2: **Relate** the concepts of mechanics with various laws of fluid mechanics.
CO3: **Identify** the laws of fluid mechanics applicable for the body in various fluids under different conditions.
CO4: **Analyse** various forces and their effects, related to fluids mechanics.
CO5: **Measure** and compare losses in different fluid flow conditions.

CO6: **Compare** different turbo machines depending on their behaviour and their merits and demerits

Text &Reference Books:

1. Fluid Mechanics by Streeter &Wylis; McGraw-Hills Pub.
2. Fluid Mechanics by Modi& Seth; Standard publishing house.
3. Fluid Mechanics by D.S. Kumar ;Katson publisher.
4. Fluid Mechanics by R.K. Bansal; Laxmi Publishing House.
5. Fluid Mechanics byYunus A Cengel& John M. Cimbala; Tata McGraw Hill Edition.

NPTEL Link for Fluid Mechanics and Hydraulic Machines

http://nptel.ac.in/courses/112105171/1

List of Experiments:

1. Calculate the coefficient of discharge of Venturimeter.
2. Calculate the Cd, Cv and Cc through Orifice meter.
3. Calculate the Coefficient of Friction through Pipe Set Apparatus.
4. Study of Viscosity of given oil through Redwood Viscometer.
5. Study of Coefficient of friction between flowing Apparatus.
6. Calculate the Critical Reynolds's Number through Pipe Set Apparatus.
7. Determination of overall efficiency of Pelton Turbine.
8. Determination of overall efficiency of Francis Turbine.
9. Determination of overall efficiency of Kalan Turbine.

Laboratory Course Outcomes: After successful completion of this course students will be able to:

CO1. **Experiment** with flow measurement devices like venturimeter and orifice meter.
CO2. **Estimate** the friction and measure the frictional losses in fluid flow.
CO3. **Predict** the coefficient of discharge for flow through pipes.
CO4. **Evaluate** pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe.
CO5. **Calculate** the Critical Reynolds's Number through Pipe Set Apparatus.
CO6. **Compare** the overall efficiency of various types of turbines.

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120305: Software Lab

Category	Title	Code	Credit-1			Practical Slot
Departmental Lab Core-DLC	Software Lab	120305	L	T	P	Max.Marks-50 Min.Marks-16 .
			-	-	2	

Course Pre-Requisites:
Engineering Graphics

Course Objectives: To make the students:
1. Develop an ability to make familiar with 2D, 3D modelling and simulation software
2. Develop an ability to create and modify complex 2D and 3D entities using CATIA software
3. Develop creative skills in developing new ideas.

SYLLABUS:

Auto CAD: Auto CAD interface, work space setting, Basic commands, viewports and printing.
Snaps: snap to grid, show to grid. Orthographic polar snap, object snap, dynamic UCS.
2D and 3D commands: Trim, extend, Offset, move, mirror, scale, rotate, extrude, union, subtract etc. commands. Units: properties, measure and dimension.

CATIA concepts: Display-Tree appearance, Three button move, view tool bar, Normal standard and shading view**,** 2D toolbar, sketch tools, constraint, profile, operation.
Toolbar: Sketch based features toolbar, commands-Pad, Pocket, shaft, groove, holerib etc. Dress up feature, Transformation features, Boolean operation.

Simulation: Assembly and simulation in CATIA, Linear and rotational motion, Nut-bolt mechanism simulation

Course Outcomes: After successful completion of this course students will be able to:
CO1 Describe AutoCAD and CATIA toolbars
CO2 Summarize 2D and 3D commands
CO3 Solve real time problems using AutoCAD and CATIA software
CO4 Analyse various mechanical engineering problems.
CO5 Evaluate technical drawings of machine assemblies as a design engineer
CO6 Generate 2D and 3D solid models with new features in machine elements

Text Books and Reference books:

1. Franke& Roger: Modelling and simulation for chemical engineering, Willey Interscience
2. Luyben-Process modelling simulation and control for chemical engineers, IInd, McGraw Hill,1989
3. Fundamentals of Engineering drawing Interactive graphics by Luzzader WJ, Duff JM;PHI
4. A general guide to computer aided design and drafting-CAD by Duggal, Vijay, cadd primer; CAD malimax publications.

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120401: Theory of Machines-II

Category	Title	Code	Credit-4			Theory Paper
Departmental Core-DC	Theory of Machines-II	120401	L	T	P	Max.Marks-70 Min.Marks-22 Duration-3hrs.
			2	1	2	

Course Pre-Requisite:
Engineering Graphics (Subject Code – 100105)
Mechanics of Materials (Subject Code – 120302)
Theory of Machines (Subject Code – 120303)

Course Objectives: To make the students:

1. Understand the basics of synthesis of simple mechanisms.
2. Apply fundamental of mechanics to machines elements which include gear, gear train, cams etc.,
3. Develop an ability to design a system, component, or process to meet desired needs within realistic constraints.

Syllabus

Unit- I Gears: Classification, Terminology, Law of gearing, Forms of teeth, Tooth profile, Cycloidal and Involute tooth forms, path of contact, teeth in contact, Interference. Spur, Helical, Spiral, Worm and Bevel gears.

Unit- IIGear Trains: Simple, Compound, Reverted and Epicyclic gear trains, Velocity Ratio. Various applications of gear trains - Motor car gear box, Differential mechanism, cyclometer mechanism etc.

Unit-III Balancing: Introduction, Balancing of rotating and reciprocating masses, Locomotive balancing, Balancing of multi cylinder in line engines, Balancing of radial engines, Direct and reverse crank method of balancing.

Unit-IV Cams and Cam Dynamics: Introduction, Classification of cams and followers, Terminology, Displacement, Velocity and acceleration diagrams for different follower motions, Synthesis of cam profiles. Cams with specified contours, Cam dynamics.

Unit-V Synthesis of Linkages: Introduction, Types, Number and Dimensional synthesis, Function Generation, Chebychev's spacing of accuracy points, Synthesis with three accuracy points of 4-bar and slider-crank mechanisms, Synthesis of crank rocker mechanisms with optimum transmission angle, Path generation.

Course Outcomes: After successful completion of this course students will be able to:

CO 1.Identify the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
CO 2.Classify various components of machines like gear, gear train cam etc
CO 3.Solve numerical problems of various components of machines like gear, gear train cam etc.
CO 4.Analyze the forces and motion of complex systems of linkages, gears and cams.
CO 5.Evaluate the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications.

CO 6.Design the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc.

Text & References Books:

1. Design of Machinery **by** Robert L.Norton; TATA McGraw Hill.
2. Theory of Machines **by** S S Rattan; Tata McGraw Hill.
3. Theory of Machines **by** R S Khurmi; J K Gupta; S. Chand.
4. Mechanism & Machine Theory **by** Ashok G. Ambekar; PHI (Prentice-Hall India).
5. Theory of Machines **by** Sadhu Singh; Pearson Education.
6. Theory of Machines and Mechanisms **by** P L Ballaney; Khanna Publishers.
7. Theory of Machines **by** R K Bansal; Laxmi Publications .

NPTEL Link for Theory of Machines-II

http://nptel.ac.in/courses/112104121/1 and http://nptel.ac.in/courses/112104114/

List of experiments

1. Study of various types of gears.
2. Study of various types of gear trains.
3. Balancing of rotating masses.
4. Balancing of reciprocating masses.
5. Study of kinematic synthesis of mechanisms.
6. Study of cams and followers.
7. To draw cam profile, velocity and acceleration diagrams of a given cam-follower mechanism.

Laboratory Course Outcomes: After the completion of the course Lab student will be able to

CO1 **Identify** the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism.
CO2 **Analyze** various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
CO3 **Determine** the degrees-of-freedom (mobility) of a mechanism
CO4 **Apply** the fundamental principles of statics and dynamics to machinery.
CO5 **Evaluate** the dynamic forces for various machines.
CO6 **Analyze** the fundamentals of machines for desired kinematic or dynamic performance.